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November 4, 1993



Secretary
FEDERAL COMMUNICATIONS COMMISSION
1919 M Street, N.W.
Washington, D.C. 20554

Dear Secretary:

Enclosed herewith are twelve (12) original copies of my Comment on Notice of Inquiry, MM Docket No. 93-225.

Respectfully submitted,

John Zuehlke

John Zuehlke
Consulting Engineer

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**Before the**
**Federal Communications Commission**
**Washington, D.C. 20554**



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| In the Matter of | ) | |
| | ) | |
| Amendment of Part 73 of the Commission's Rules to Clarify the Definition and Measurement of Aural Modulation Limits in the Broadcast Services | ) | MM Docket No. 93-225 |

TO: Secretary

COMMENT ON NOTICE OF INQUIRY

Adopted: July 23, 1993; Released: August 12, 1993

Since 1983, the American FM Broadcaster has suffered under the burden of trying to second-guess what the Federal Communications Commission would consider to be acceptable levels of overmodulation. Not only has the Commission never given "a general definition of the term 'peaks of frequent reoccurrence'"[1], it compounded the problem by removing the type-approval procedure that provided the broadcaster with the assurance that the instrument he relied on to adjust the modulation chain would, if properly used and maintained, keep him a legal good adjacent-channel neighbor. Currently the

[1]Federal Communications Commission, MM Docket No. 93-225 Notice of Inquiry, p.2, footnote 10.

broadcaster is confronted by a variety of modulation monitoring equipment from several manufacturers. He has no effective "yardstick" with which to measure whether any particular monitor will prove suitable for making these all-important measurements. And woe be it to the broadcaster who succumbs to the temptation of the "snake-oil" modulation monitor salesman who promises that his product has a magic transient processing algorithm that will allow the broadcaster to increase his modulation percentage in a very competitive market while believing he is still legal.

Even absent this drastic scenario, the Commission has acknowledged that confusion exists when it stated: "Some (broadcasters) continue to use monitors which were type approved by the Commission in earlier years, while others use a variety of newer devices employing sophisticated circuits which can be adjusted to respond to or ignore modulation peaks of different intensities and durations. ...some modulation monitors...can be adjusted so as to give differing indications for the same transmissions."[2]

The Commission is to be commended for their recognition of this problem and their stated willingness to try to correct it. Clarifying those rules that are ambiguous will provide some degree of help to the

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[2]ibid., pp. 1-2, paragraph 5.

broadcaster, but the best solution would involve the re-institution of a type-approval or similar process for modulation monitors.

The present Notice of Inquiry, however, suggests that the F.C.C. may be considering the radical course of "eliminat(ing) specific limits on modulation *per se* and replac(ing) them with a new emission limitation..."[3] I not only believe that this type of drastic action could prove very detrimental to the broadcast industry by creating even more confusion than currently exists, but I also question whether there even is a need for taking any such action at this time.

## I

## IS THERE AN OVERMODULATION PROBLEM THAT REQUIRES A RADICAL CHANGE IN MEASUREMENT TECHNOLOGY?

In the present Notice of Inquiry, the major justification for radical change seems to be that the current "'step function' (emission) limitations ... (that) were developed decades ago, are extremely simplistic approximations of signal envelopes and, <u>for this reason</u>, do not afford adequate channel protection." (emphasis added)[4] The present Notice of Inquiry makes no mention of the Commission having documented numerous

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[3]ibid., p.3, paragraph 11.
[4]ibid.

cases of adjacent-channel interference in the FM broadcast band directly attributable to stations judged to be properly operating under the current "step function" approximation. Would the interference not have occurred if the proposed continuous function limitations had been in effect at the time? (It should be noted that continuous functions are only realizable in the analog realm; the nature of the digital world is that everything is a step function approximation!)

The Commission's statement that "we note from our enforcement experience that instances of overmodulation do not commonly involve borderline judgments; stations which overmodulate tend to do so in an egregious manner which is apparent from any measurement method used"[5] adds weight to the argument that this proposed change from a step-function approximation to a continuous one isn't warranted.

## II

## THE REQUIREMENTS OF FUTURE DIGITAL INBAND BROADCASTING HAVE YET TO BE DETERMINED.

Since the Commission has yet to endorse any digital broadcast system (or even general methodology), any changes to the spectral requirements based on the conjecture of future utilization for inband digital audio

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[5]ibid., p.2, footnote 12.

would be premature at this time. It should be noted that the need for more stringent spectral purity requirements to accommodate digital broadcasting channels within the current FM broadcast band has not been established: One of the competing systems recently demonstrated seemingly flawless digital transmission inband and on-channel with a conventional FM station that was simultaneously running an ERP several orders of magnitude above that of the digital transmitter!

## III

## SUBSTITUTING A SPECTRAL DEFINITION OF MODULATION LEVEL DOES NOTHING TO ELIMINATE THE CONFUSION OVER PERMISSIBLE AMOUNTS OF OVERMODULATION.

Substituting a spectral definition of permissible modulation level for the current direct modulation level standard does nothing to correct one of the major ambiguities of the existing standard: The lack of a clear definition of what constitutes and how to quantify overmodulation "peaks of frequent reoccurrence," which has been a cause of significant confusion among broadcasters and equipment manufacturers alike.[6] Since the Commission has clearly chosen to allow occasional overmodulation on signal peaks, it is reasonable to

[6]ibid., p.2, footnotes 9-11.

assume that the Commission will also allow the concomitant excessive occupation of bandwidth on peaks that are not of "frequent reoccurrence."

## IV

## CONVERTING TO A SPECTRAL DEFINITION OF MODULATION LEVEL WOULD PROVE CONFUSING, COSTLY, AND COULD REQUIRE THE DEVELOPMENT OF A WHOLE NEW REALM OF AUDIO PROCESSING AND MEASUREMENT TECHNOLOGY.

The broadcaster's entire signal string from console through audio processing and limiting through to the FM exciter has controls that directly affect the level of modulation in a simple, easy to comprehend and adjust way. While the broadcaster relies on his modulation monitor (which is essentially a high quality FM receiver with specialized metering) to verify that the system is modulating properly, he really depends upon one or more audio compressors and/or limiters to automatically regulate modulation level. Unfortunately, in the event of a spectral density based regulation replacing the current modulation level requirements, the broadcaster is faced with two severe technical problems:

First, the only controls that he has are essentially gain controls that directly affect modulation levels. These can be set by simply referencing a level or modulation meter. No analogous controls directly control

the emitted spectrum, and no simple instrument gives direct feedback of the results. No matter how permissible modulation is defined, and no matter whether he uses a simple meter as a direct reference or has to make a complex interpretation of occupied bandwidth from the screen of a spectrum analyzer, he still will end up adjusting his modulation gain controls!

Second, most broadcasters rely on automatic gain controlling amplifiers known as compressors and limiters to compensate for the variations in audio level and board operator dexterity to maintain a consistently high (but legal) modulation level. An automatic modulation controller that was required to regulate spectral density, whether by means of RF occupied bandwidth or by inference from audio level vs. frequency analysis, would have to be developed and would probably be quite costly.

For example, an audio limiter/processor that could control the radiated spectrum of the station would probably have to continuously and in real time compute the Bessel Function of the audio input and the expected modulation transfer function of the exciter, compare those results to the permissible radiated spectral curve, and then either change overall signal gain or compute some distortion to the audio frequency response that will bring the radiated signal into compliance.

V

COST OF IMPLEMENTATION.

The cavalier attitude expressed by the Commission in this Notice of Inquiry regarding the possible high cost of the new equipment needed to make spectral measurements[7] is quite disconcerting in this time of rapidly shrinking advertising revenues and decreasing station profitability. The mitigating measures of "licensees ... sharing more expensive measurement equipment, or subscribing to over-the-air monitoring services, or depending on their consulting engineers to provide necessary equipment measurement capabilities"[8] is untenable because the law requires a station to be in compliance at all times while on the air. Without full-time access to modulation monitoring equipment a station has no method of checking whether some minor drift in a compression amplifier or limiter is not creating adjacent channel interference and bring down a citation. In the case of a spectral definition of modulation things get even worse. Even the change of an audio equalization control that may go totally undetected by a console meter or limiter will change the radiated spectrum, perhaps illegally. Therefore, continuous monitoring capability is even more necessary under the proposed defined spectrum rules.

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[7]ibid., p.4, paragraph 17.
[8]ibid., p.4, paragraph 20.

## CONCLUSION

I strongly endorse the Commission's clarification of those modulation rules that are ambiguous, but believe that the desirability of making any radical changes in the way that modulation levels are determined is not supported by the available data. Changing to a radiated spectrum modulation standard would cause massive and costly disruption to the broadcaster's audio and monitoring systems, make measurements far more complex, and require that the necessary adjustments be based on inference from measurements rather than directly on the measured results. This would only serve to increase confusion and error.

Respectfully submitted,

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